



March 17, 2007

The Honorable John D. Dingell
The Honorable Rick Boucher
Committee on Energy and Commerce
U. S. House of Representatives
2125 Rayburn House Office Building
Washington DC 20515

RE: Dealing with Transportation Emissions in Climate Change Legislation

Dear Representatives Dingell and Boucher:

This letter describes a new alternative approach to setting up a cap and trade system for the transportation sector—one that, because of the increased flexibility that it offers and its vesting of responsibility and resources with industry, should be one that both industry and environmental groups would welcome and support.

Having, along with my late supervisor at the Lawrence Livermore National Laboratory (LLNL), first submitted testimony regarding the threat of climate change to the House Subcommittee on Environment and the Atmosphere of the Committee on Science and Technology in 1975, I am very pleased that proposals to limit and then reduce emissions are finally receiving attention, even if I wish action could have come some years ago. Although I am now officially retired from LLNL after 34 years of research dealing primarily with climate change (from 1993-2002 on detail as a senior climate change scientist with the Office of the US Global Change Research Program—about half as executive director of that Office and the other half as executive director of its National Assessment Coordination Office), I am still quite active in analysis and interpretation of climate change and its impacts. Based on nearly four decades of study of the global climate and factors that are affecting it, the accelerating pace of climate change clearly indicates that it is time (actually past time) to take serious actions to limit ultimate change and to adapt to the changes that are inevitable.

While I am a physical scientist and not an economist, my many years of participating in the study of climate change lead me to suggest an approach that I think would work much better than many of the frequently proposed approaches. As an underlying principle, it is my view that a cap and trade system (based on permits, each with an allowance for a certain amount) will be most efficient and effective if the permits are held by the entity (or entities) that have the widest variety of options for altering emissions. In my view, flexibility is the way to keep any costs to a minimum and to maximize creative potential for dealing with this issue.

Most cap and trade proposals start with the utility industry because it is obvious that utilities have a range of options for switching away from fossil fuels (e.g., renewables, nuclear, encouraging efficiency increases, load balancing measures, etc.). For transportation, the challenge is greater. Traditional views for limiting emissions from the transportation sector have been to: (a) directly increase the cost of the fuel for the consumer via a carbon tax; (b) indirectly

increase the cost of the fuel for the consumer by requiring the fuel refiners to hold permits for the fuels they produce (costs that would inevitably be passed directly to the consumer); and (c) mandate performance standards (e.g., increase CAFE standards). Raising the cost of fuel (directly or via refiner-held permits) attempts to transform the system by creating disincentives for consumers (a generally slow process as they can buy only what is available), sends the money to the refiners or the government, and provides little help or incentive to automobile manufacturers—and so they tend to resist. Mandating minimum performance standards only affects new vehicles and so is slow to have an effect, causes problems for manufacturers, performance standards tend to only be slowly increased, and the process seems to require Congress to get involved in engineering and marketing details, etc. None of these approaches really promotes the type of aggressive transition across the transportation sector that is needed or creates incentives for those in the industry to really take the lead instead of slowing the transition.

While it is also likely necessary to generally raise the cost of fuel over time to give a push to consumers, I believe that my alternative approach will provide significant incentives to manufacturers to lead the transition, and also has provides some other benefits while introducing relatively few complications. Basically, the notion is that each manufacturer of an in-use vehicle¹ (so, of automobiles, trucks, construction vehicles, buses, tractors, aircraft, ships, trains—generally, the more inclusive the better, though this is not required) would, for any year, have to hold a number of emission allowances (allocated via permits) that would cover *all* of the greenhouse gas emissions (mostly fossil fuel-derived carbon dioxide from petroleum, coal, and natural gas) from all of the vehicles they have ever produced that are still in use within the United States (or some larger domain if appropriate agreements can be reached). Thus, for example, the set of automobile and truck manufacturers (e.g., General Motors, Ford, Toyota, etc.) would collectively have to hold enough permits to cover the consumption of all of the gasoline, diesel fuel, and compressed natural gas burned each year in all vehicles they manufactured that are still in use; similarly for the aircraft, rail, shipping, and any other sectors. Legislatively, this could be done by making each manufacturer into a special transportation facility, or something similar.

The total number of permits created in year zero (or some initial average of years) of the program would cover all the fossil-fuel carbon used by the transportation sector—a number that can be pretty readily determined (as explained further below). A manufacturer's share of the total number of permits would be distributed free of charge (as explained below, the allocation can likely be quite easily determined). So, there would be no up-front cost to the manufacturers via auctioning the permits. Because each manufacturer would want their fair share, each would likely watch over how many other manufacturers were claiming. These permits would be valid for some multidecadal period, not reissued every year; new manufacturers would need to purchase permits from the existing set issued, or perhaps a small amount could be withheld for new manufacturers meeting some performance standard. However, the emissions allowance associated with each permit would depreciate over time at a rate of something like 1.5-2% of its original value per year (the depreciation rate could perhaps be phased in and increase over time). The intent and effect of this depreciation would be to cap and reduce the total amount of fossil

¹ One might also include some other users of petroleum, including: off-road vehicles, chain saws, lawnmowers, etc. Actually, the greater the scope, the more options become available for reducing emissions—and generally, the more options, the less cost.

fuel used in the transportation sector each year, getting down to perhaps 5-10% of the present level over 50 years—climate change is that urgent an issue.

As for other cap and trade systems, the emission allowances could be sold (if they have extras), traded, banked for later use, or purchased, either on a one-year or multi-year basis. As appropriate, this could be done within the transportation sector or across sectors (e.g., with electric utilities, etc.). The key national/Congressional interest is in limiting total emissions, not in who is responsible for them. Instead of providing a safety valve sale of extra permits (we really do need to cut emissions, so a hard cap is needed), borrowing would be allowed against future allowances on some basis that would assure this would not just lead to defaulting in future years. The only requirement would be that each year each manufacturer must surrender enough allowances each year to cover all of the emissions resulting from all the transportation vehicles or other systems they have ever made that are still in use (so, for example, all gasoline use would have to be accounted for and covered). By dealing with a relatively small set of manufacturers (one of the factors that made the Montreal Protocol successful), implementing such a system should be pretty straightforward.

The free allocation provides the manufacturers a potentially very valuable asset. Along with it goes, however, the responsibility for the sharp, long-term reduction of transportation related emissions. I believe this is a bargain that the manufacturers should willingly take on. By concentrating the permits in the hands of entities that can make changes, this should create just the type of incentives and resources that are needed.

So, what are their options for dealing with the depreciating allowances? While the Pew Center has proposed using a permit system to cover the transportation sector, they would require, as I understand it, the vehicle manufacturers only to hold permits for the greenhouse gas emissions from the new vehicles that are sold each year. My proposal goes much further. By making the manufacturers responsible for all past vehicles they have manufactured (after all they do deal with their past vehicles through various maintenance and parts programs), a wide range of options relating to the use and lifetime performance of all their vehicles opens up. For example, manufacturers could, at their option, to varying degrees, and on their time schedule:

- Improve the performance of new vehicles of whatever vehicle type (trucks, vans, cars, large cars, whatever) they think they can make the most progress on (e.g., lowering vehicle weight using composites, improving engine efficiency, improving aerodynamics, deactivating some cylinders when not needed, etc.). Note that there will be a natural gain as a result of older cars being scrapped and better performing cars being sold that should deal with the need to increase the overall number of vehicles for a growing population.
- Change over to hybrid or diesel engines, or later to hydrogen engines.
- Move to plug-in hybrid systems and work with the utilities to develop systems that let the consumer recharge at times of day when the rates are lowest. My understanding is that the test vehicles in Austin, Texas, which are recharged at night using Texas wind power, have a fuel cost equivalent to gasoline (without taxes) of less than a dollar a gallon—this would be advantageous for the consumer and, in that fossil fuel use is being replaced by electricity, advantageous for the manufacturers. [Note that using electricity to replace gasoline would transfer the responsibility for permits to the utilities, which in turn have their own set of options for avoiding use of fossil fuels.]

- Move to other even newer types of alternative engines, using ideas such as those described at <http://www.cnn.com/2007/TECH/03/09/cars.100mpg.popsci/index.html>.
- Not only make their vehicles capable of running on biofuels, but encourage biofuel use by consumers (a situation now handled in a not very satisfactory way in the CAFE standards).
- Purchase and take out of service older gas-guzzling vehicles (this would be similar to some air quality related control measures, and would have the side benefit of raising the value of the worst performing cars; because such vehicles are often owned by the poor, using a gas tax to reduce their gasoline usage is a very regressive tax, whereas this system would provide the funds to help them upgrade to a better vehicle).
- Retrofit some of the vehicles they have already produced (including, for example, farm tractors) for use of biofuels or mixed fuels (and the manufacturers would then likely also push for greater biofuels production and overall use).
- Build energy efficient replacement engines or conversion systems.
- Enhance vehicle maintenance programs.
- Encourage raising the cost of fuel and using the funds, for example, for priority highway projects to reduce congestion.
- Encourage other ways that limit congestion (encourage car-pooling, high occupancy vehicle lanes, smart stoplights, systems that promote efficient routing, congestion tax, etc.)
- Encouraging mass transit, travel by bicycle (so bike trails), etc.
- Providing a way that truckers can turn off their engines during rest times (perhaps plug-in facilities at truck stops).
- Encouraging more use of rail to replace long-haul trucking.
- Market specialty vehicles (e.g., small electric vehicles for in-town use, cars or advanced Segway Personal Transporters, motor-assisted bicycles, spruced up motorcycles, etc.) and setting up programs to rent such vehicles for visits in urban areas, etc.).
- If multiple countries are covered, deciding in which country to take which action or make which improvement (again, the goal is reduction in overall emissions, independent of where they occur).
- Sequencing their actions in time to achieve maximum benefit and lowest cost (e.g., not waiting for a new vehicle year to release a new product; coordinating rollout of related steps, etc.)
- Focus their advertising campaign on achieving their program (e.g., switching to hybrid vehicles, replacement of old vehicles, not using low-mileage vehicles except when really needed, etc.).
- Working with rental car companies to have available and market the most efficient cars
- Working with fleet operators to improve their efficiency of operation (e.g., having optimally sized trucks, etc.).
- Producing and promoting hybrid buses or other specialty vehicles, etc.
- Encouraging and promoting more use of passenger rail.
- In addition to improving aircraft performance, the aircraft engine manufacturers would want to find ways to reduce flight congestion and waiting times, size planes for loads and routes, perhaps even encourage rail for short flights, etc.
- Joint agreements with energy users in related fields (e.g., assisting lawnmower manufacturers to switch fuels from gasoline to electric in exchange for gaining their permits).

These are only some ideas; with so many possibilities because more than new car mileage is being addressed, the incentives should surely stir the manufacturers and users to come up with more. While penalties would be needed if a manufacturer's allowances were not up to the calculated fuel use, the intent would be to work more through incentives and flexibility (e.g., with the ability to borrow, penalties might only be needed for exceeding the set of allowances over a multi-year period). Indeed, the main focus for Congress should be to create incentives for taking action and for invigorating the research and remodeling efforts of the manufacturers (and hopefully, as well, to create jobs). The manufacturers not only get to choose the changes, but also will have the opportunity and choice to promote their approaches through their advertising and advocacy efforts. Making the manufacturers the holders of the permits and allowances therefore seems likely to me to provide the financial incentive needed to make the significant changeover that is needed.

Clearly, this type of approach would be better than simply raising the cost of gasoline (via a tax or a permit system applied to refiners) and expecting some response driven by consumer pressure. Traditional economics says it does not matter where in the chain a cost is imposed, the effect will eventually spread through the system. This may well be true in the long-term, but we do not have the time—we need rapid and prompt and definitive action all across the spectrum of possibilities, and this can only happen if those who can make changes happen are given the incentive for this to happen.

So, what are the potential problems with this approach? As to the challenge of determining the level of emissions of each manufacturer, a significant amount of data is available to enable this to be done. For example, refinery production will indicate the total carbon use for all manufacturers, so the real challenge would really be in allocating this total among manufacturers. With only a dozen or so major automobile manufacturers involved (and not too many more even when including rail, aircraft, construction, and other manufacturers), this should be a quite doable task. For example, state registration records provide good data on the number of vehicles in use for each manufacturer, and mileage records for the cars are typically available from state inspection programs (or vehicle maintenance records). State inspection records also often give an indication of car performance (in that emission standards are measured in grams per mile in a standard test). For at least a representative set of drivers, credit card records would indicate how much fuel was purchased for particular types of vehicle. Data from vehicle fleets could also be useful. I would venture to suggest that, with the total allocation of permits for this sector set by well-defined estimates of total fuel consumed, the vehicle manufacturers could be expected to quickly come up with a formula for the allocation among manufacturers—and if they could not, EPA surely could do so quickly. Thus, it should be quite possible to implement this approach very quickly and simply.

In suggesting this approach to including the transportation manufacturers in the permit system, I do not mean to suggest that one would simply ignore also creating incentives for changes by consumers by, for example, increasing the cost of fossil-based fuels, promoting mass transit, using congestion taxes, etc. However, for significant change to occur, I believe there needs to be a significant accumulation of the permits in the hands of the entities that can make large changes—and the manufacturers, with their capabilities to develop new technologies, make

agreements across sectors, and compete to find the lowest cost way of doing this, would seem to be the sector of the economy with the most options.

I would also note that using this approach would have a number of side benefits. As mentioned above, low mileage cars, often owned by the poor, would now be worth a bit more, so there would be some additional ability of the poor to change to better mileage vehicles. Further, the multiyear rights to the permits for each manufacturer's fleet could be an important asset for companies whose sales are dropping; because more old cars would be scrapped than new vehicles sold, they could use any excess permits to raise capital to make changes in their vehicle lines, to pay off debts or worker obligations, to save for future growth, etc. Third, such a multi-decadal system would provide a long-term incentive for a very influential industry to push very hard to address the climate change issue—they would have the opportunity to become part of the solution instead of part of the problem. And fourth, by having the cap and trade system extending across a wider fraction of the economy, the ultimate solutions would be likely to be more efficient, because creating barriers and different systems for different sectors tends to lead to inefficiencies.

Note that this approach could be applied to not only the United States, but the domain could include any larger area. For example, in that they have a similar set of vehicle manufacturers, Canada, Mexico, and then other countries in the Americas could be included. The domain could also readily be extended and cover the OECD countries. In any case, the approach would apply to manufacturers wherever they are located if they have vehicles within the covered domain—so manufacturers in Korea or China, for example, would have to have permits for the use of the vehicles they have manufactured that are in operation within the domain of interest—the rules would apply to all, focusing on where the vehicles are being used rather than where they are made. This might well have the side effect of promoting spread of the most effective technologies throughout the world, which could be beneficial. And manufacturers would benefit from the domain being larger as they would have additional options for cost effectively reducing use of fossil fuels being able to choose different options in different locations and to phase them in as they deem most appropriate for their business.

Finally, a few additional points for consideration. Multi-decadal permits would give the holders of the permits considerable flexibility (through borrowing of allowances) to efficiently meet their requirements, including dealing with fluctuations in sales and in the business cycle, etc. Second, by setting out the requirements for a multi-decadal period, over which time the US is going to have to get its emissions down by a factor of roughly ten, will provide the long-term picture and regulatory stability needed to attract investment in technological advances. Both of these actions would therefore be likely to help improve the overall efficiency of the transformation that is needed—enhancing flexibility while giving a very clear signal of the long-term path that is required. In my view, legislating short-term actions with frequent reviews would give the signal that the commitment to the transformation is only tentative (so why make long-term investments). Given the long time horizon, planning can go forward for the large changes that are needed.

Because of the large number of options available to manufacturers, economic analysis of this approach's impacts using traditional equilibrium economic models is unlikely to be adequate. With most of my attention focused on climate change itself, my limited efforts to encourage such

analyses and turn these ideas into a formal publication have not yet been successful—what is really needed is for the manufacturers to lead in carrying out an analysis of such an approach. With the issue now being seriously addressed by the Congress, I am hopeful that consideration can at least be given to what seems to me a far superior approach to those being considered to date.

Please contact me if I can provide further input or clarification. It really does seem to me as if this approach should be attractive to the manufacturers, and, because it would lead to significant reductions in emissions, should be attractive to the environmental community. If this could be the case, then it should be a win also for the Congress as well as the environment.

Sincerely yours,



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² Brief biographical note: On a voluntary basis, I am presently serving as Chief Scientist for Climate Change with the Climate Institute, which is based in Washington DC and is the oldest NGO exclusively focused on climate change. After receiving my Ph.D. in Applied Science from the University of California Davis/Livermore in 1968, I joined the University of California's Lawrence Livermore National Laboratory (LLNL) as an atmospheric physicist. At LLNL, I carried out research for the next 25 years focused on numerical modeling of various causes of climate change (including study of the potential climatic effects of greenhouse gases, volcanic aerosols, land-cover change, and nuclear war) and of factors affecting air quality (including photochemical pollution in the San Francisco Bay Area and sulfate air pollution in the northeastern United States). In addition to pursuing my scientific endeavors, I also served as deputy division leader for atmospheric and geophysical sciences from 1974-1987 and division leader from 1987-1993.

From 1993-2002, I was on assignment as senior global change scientist to the interagency Office of the U.S. Global Change Research Program (USGCRP) in Washington D.C., also serving as its first executive director from 1993-1997. From 1997-2001, I served as executive director of the USGCRP's National Assessment Coordination Office, which coordinated the efforts of 20 regional assessment teams, 5 sectoral teams, and the National Assessment Synthesis Team that prepared the report *Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change* that was forwarded to the President and on to the Congress in 2000. During this period with the Office of the USGCRP, I also coordinated the official U.S. Government reviews of several of the assessment reports prepared by the Intergovernmental Panel on Climate Change (IPCC) and prepared the chapter on impacts and adaptation in the *US Climate Action Report 2002* that was submitted to the UN Framework Convention on Climate Change.

When my assignment with the Office of the USGCRP concluded on September 30, 2002, I simultaneously retired from LLNL. Since that time, I have served on the integration team for the *Arctic Climate Impact Assessment* and worked on a number of projects with the Climate Institute. In 2003, I was elected to a 4-year term as president of the International Association of Meteorology and Atmospheric Sciences (IAMAS), and simultaneously serve on the executive committees of International Union of Geodesy and Geophysics (IUGG) and the Scientific Committee for Oceanic Research. I also recently served as a coordinating lead author for the report *Confronting Climate Change: Avoiding the Unmanageable and Managing the Unavoidable*, that was prepared by the Scientific Expert Group on Climate Change on Sustainable Development under the sponsorship of Sigma Xi and the UN Foundation. I am a fellow of the American Association for the Advancement of Science (AAAS) and a member of the American Meteorological Society, the Oceanography Society, and the American Geophysical Union.